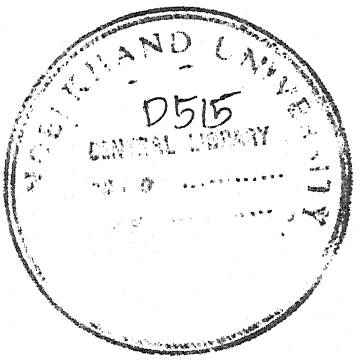
STUDY OF INTRA-OCULAR PRESSURE IN DIABETES

THESIS

FOR

DOCTOR OF SURGERY

(OPHTHALMOLOGY)



BUNDELKHAND UNIVERSITY

JHANSI (U. P.)

1992

NUPUR SUMAN

DEDICATED TO

MY FATHER

WHOSE, SIMPLICITY, GENEROSITY, HONESTY AND INTEGRITY I ALWAYS ADMIRED. HE HAS ALWAYS BEEN A MASTERPIECE IN MY MIND.

MY MOTHER

FOR HER LOVE AND AFFECTION.

C O N T E N T S

A C K N O W L E D G E M E N T S

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Finally it is with pleasure that I acknowledge the effecient and willing co-operation of Mr. K. C. Sharma in typing the manuscript.

Dated:

(NUPUR)

C E R T I F I C A T E

This is to certify that the work entitled "A STUDY OF INTRA OCULAR PRESSURE IN DIABETES", which is being submitted as thesis for M.S.(Ophthalmology) examination of Bundelkhand University, 1992, by Dr. Mupur Suman, has been carried out in the Department of Ophthalmology.

She has put in the necessary stay in the Department according to the University regulations.

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This is to certify that the work entitled "A STUDY OF INTRA OCULAR PRESSURE IN DIABETES", has been carried out by Dr. NUPUR SUMAN, under my direct supervision and guidance in the Department of Ophthalmology, M.L.B. Medical College, Jhansi. She has fulfilled necessary requirements of the stay in the department for the submission of the thesis. The techniques and observations incorporated in this thesis have been undertaken by candidate herself and checked by me from time to time.

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INTRODUCTION

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Diabetes mellitus is the most common of the serious metabolic diseases of humans. True frequency of the general population is difficult to ascertain, because of differing standards of diagnosis, probably is somewhere around 1%. In United Kingdom 1.2% of the population have diabetes about half are known to have diabetes and the rest can be estimated by population studies. Estimates for Insulin dependant diabetes mellitus are much more reliable than non-Insulin depandant Diabetes Mellitus, since most young patients are diagnosed after the appearance of symptoms. In England prevalance of Type I illness has been estimated to be 0.22% by age 10 year and in United States a study in Alleghene country, pennsylvania suggested a prevalance of 0.2% by age 20. Insulin dependant (Type I) diabetes is due to damage to the Beta cells of pancreatic islet of Langerhans. It is not directly inherited, although individuals may inherit a predisposition associated with certain HLA types. The peak incidence is 10-20 years, although elderly patients can also be insulin dependant. Non insulin depandant (Type II) diabetes has no known cause, although in many cases there is a strong genetic

component, unrelated to the HLA system. It is most prevalent after middle age and occurs most frequently between the ages of 50 and 70 year, although there is a certain amount of overlap between the two types of diabetes.

The disease is characterised by series of hormone induced metabolic abnormalities; by long term complications involving the eyes, kidneys and blood vessels. Diabetes, besides its other ocular menifestations, also affects the intraocular pressure. Diabetics are more prone to have primary open angle glaucoma, Pallomar, in a comprehensive review states that chronic simple glaucoma dosen't occur more frequently in diabetics than in general population and that it is generally known that routine tonometery gives a lower average tension in diabeties, whereas Armstrong et al. (1960) reported evidence of 4.1% of chronic simple glaucoma in diabetics, was almost two times higher than reported in most of the studies of general population.

The risk of blindness is about 25 times greater in diabetics than in non-diabetics. Diabetic Retinopathy is a leading cause of blindness in United States between the ages of 20 and 65 years. The frequency of retinopathy

appears to vary with age of onset as well as with to duration of disease. Approximately 85% of patients eventually develop retinopathy but some never develop ophthalmoscopically visible lesions even upto 30 year of disease. Absolute figures vary, however, depending upon the method of patient selection. In the recent study of prevalance of diabetic retinopathy among the patients at Joslin clinic, a sample of records of patients attending the clinic throughout a six month period was rewewed. The prevalance of Diabetic retinopathy was 25% in this total diabetic population, 7% in patients with diabetes for less than 10 year; 26% in patients with diabetes for 10-14 year; and 63% in patients with diabetes for 15 year or more.

Diabetic retinopathy can be broadly divided into two forms. In the majority of cases the lesion consists of Microaneurysms, haemorrhages, lipid enudates and retinal edema; this may be termed as Simple Diabetic Retinopathy. Superimposed on this form is another more virulent type, PROLIFERATIVE DIABETIC RETINOPATHY, characterized by formation of new vessels in the retina and proliferating into the vitreous. It has been estimated that 10-18% of patients with simple retinopathy progress

to proliferative disease in a 10 year period.

The evidence of specific changes in the fundus of sufferurs from Diabetes Mellitus was first described by Von Jaeger (1855) and at a later date many menifestations which had been observed were fully elaborated in a classical paper by Hirchberg (1890-91). The fundus abnormalities seen in Diabetic retinopathy consists of changes within the retina, in front of retina and within the vitreous cavity. The intraretinal changes compose the non-proliferative or simple phase of the disease, while the preretinal and the vitreous alterations make up the proliferative or malignant phase. Non proliferative changes are first to occur and they may or may not develop into the proliferative phase.

Diabetes besides its other ocular menifestation also affects its intra ocular pressure. The mean intra-ocular pressure in maturity onset diabetes (MODM) is 19.26 mmHg which is higher than the normal limits of intraocular pressure reported in general population i.e. 16.1 mmHg (Becker and Schaffer). The tonometer is a device that measures the pressure through the eye ball. The first practical tonometer was that of Maklekoff (1885).

The second applanation tonometer Fick (1888) employed a fixed area of flattening produced by an adjustable force. The modern version of this instrument, Goldmann (1954) is a very accurate clinical tonometer. An applanation tonometer that has been proved to be useful in the face of corneal edema or scarring as well as in healthy cornea is the Mackay-Marg tonometer. Kraker has recently developed a tonometer that senses vibration, characterstic of corneal indentation tonometer's, have been in use over longer than applanation tonometers. Most widely accepted indentation tonometer is the one deviced by Schiotz.

The present study is undertaken to evaluate the intra-ocular pressure in normal and Diabetic patient and also to assess the changes in different grades of diabetic retinopathy.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Diabetes is a major health problem throughout the world. Increased survival rates among diabetic patients have led to a large increase in the number of people who develop long term complications of diabetes. These include retinopathy, cataract, nepheropathy, neuropathy, and other vascular complications. Statistical data about the incidence of blindness due to its ophthalmic complications is 20 times more than the incidence of blindness in general population. According to data from statistics on blindness in model reporting area, 1969-70, diabetic retinopathy was responsible for 11.1% of the new cases of legal blindness in all the age groups and 19.1% of those in the 20 to 64 year age group.

The risk to develop blindness from diabetic retinopathy also increases with the duration of disease. According to estimates of Caird et al., 1969; the percentage risk of blindness among patients diagnosed at age 20 (Juvenile) was 0.1% after 10 years of diabetes, increased to 1.6% after 20 years, and to 3.5% after 30 years. Among patients diagnosed at age 40 (MODM), risks were 0.8% after 10 years, 3.8% after 20 years, and 7.1% after 30 years.

Total incidence of retinopathy in type I diabetes is :-

- 20-30% after 5-10 year's
- 30-50% after 10-15 year's
- 70-80 after 15 year's or more

Diabetic retinopathy, first described by Von Jaeger in 1855 is one of the major tragedies of ophthalmology, in our present generation. It is predictable but not preventable, chronic and progressive in its course and leading to blindness in detressing percentage of cases. Approximately 2% of all diabetics are blind due to retinopathy and the prevalance increases 5-10% in patients who have had the disease for more than twenty years. Diabetic retinopathy has been divided into two large catergories - simple and proliferative. Retinopathy appears to develop earlier in older patients. Approx 10-18% patients with simple retinopathy progress to proliferative disease in a 10 year period.

Mekenzie and Nettleship (1877) were the first to discover capillary aneurysm in a case of glycosuria, it was not until 1943 that Ballantyne and Lowenstein

succeeded in proving that the earliest sign in diabetic retinopathy is the microaneurysm. Venous abnormalities are among the commonest manifestations of diabetic retinopathy. Dilatation, irregularity and increased tortousity of the retinal veins are all seen. Haemorrhages, most characteristically occuring in the deeper layers of retina and hence round and regular in shape are also a relatively early feature of diabetic retinopathy (Ballantyne and Lowenstein 1943), the smaller ones may be difficult to differentiate ophthalmoscopically from a micro-aneurysm, and the two are often grouped together as 'dots and blots' Hard and Soft exudates also occur. Hard exudates are more common. They are yellowish with irregular sharply defined edges, varying in size from tiny speaeks to large confluent often circular patches. As was first described by Manz (1876) and Nettleships (1888), in a number of diabetics, new vascular formation with attendant connective tissue develop from the retinal vessels, a most omnious state as the vision is then lost within a few years. New vessel formation are usually more marked in an area around the optic disc,

but they may occur in relation with retinal vessels anywhere between the disc and the periphery and are often multiple, particularly in vicinity of diseased retinal veins (Ballantyne 1946; Ballantyne and Michaelson 1947; G. Scott 1951; Kornurup 1958; Larsen 1960). Recurrant vitreous haemorrhages from the delicate new vessels are the most dramatic complication of proliferative retinopathy and for this reason, a sudden loss of vision in a diabetic nearly always betrays the existance of neovascularization. In the final stage of proliferative retinopathy, there is a gradual regression in the site and number of new vessels, at the same time the connective tissue surrounding them increases in density and contracts into sheets or bands. Although this change involves a [illegible] liability to vitreous haemorrhage, the vision is greatly at risk caused due to the risk of traction bands thus formed leading to detachment of retina (Gartner, 1950); the bands may also drag the retinal vessels out of their usual course and be a factor in the production of venous occlusion which commonly occurs (Hanum, 1938; Davenger 1961; Whittington 1964).

INCIDENCE OF DIABETIC RETINOPATHY

The general incidence of diabetes mellitus is high for its affects between 1-4 to 1.7% of population. It occurs particularly in people in fifth and sixth decade of life. The reported incidence of diabetic retinopathy in sufferers from diabetes mellitus depends on several factors, most important being the age of onset of diabetes, length of duration, control of glycosuria and above all, on the deligence of the observes in searching for the early disease there has been a continous increase in the frequency of diabetic retinopathy in past few decades Wagener figure on this point are illuminating; in 1921 immediately prior to the introduction of insulin, found an incidence of 8.3% of diabetic retinopathy among diabetics (Wagener and Wilder, 1921), in 1934 the incidence has risen to 17.7% (Wagener et al. 1934); and in 1945 29.6% (Wagener, 1945). Typical figures based on large number of patients are those of Kormurup (1957) who found 601 cases of diabetic retinopathy in 1285 unselected diabetics (47%) and Dollfus (1945), 681 cases in 1,303 patients (52.4%). It follows that, at present time diabetic retinopathy may be expected to develop at least in 50% of all the

cases of diabetes. In evaluating the statistics one has to consider the facts that until the introduction of insulin in 1921 many patients died before the occurance of retinopathy, while thereafter they continued to live to develop retinopathy and also that examining techniques are much more precise today than they were years ago. This is due to the improvement of ophthalmoscope and slit lamp and fluorescien angiography.

DIABETIC RETINOPATHY IN RELATION TO THE AGE OF DIABETIC PATIENTS

The first report of diabetic retinopathy by V. Jaeger (1954), was based on the findings in a 22 year old, gardener. However most of the workers have stated that retinopathy is common in patients of middle or advanced age and rare in younger people and extremely rare below the age of 10 years, whatever the duration of diabetes may be (Forsyth and Payne, 1956; Imerslund, 1959; Girner, 1960; Guest, Lample, Kessler and Skillman, 1965).

DIABETIC RETINOPATHY IN RELATION TO DURATION OF DIABETES

The duration of diabetes is the most common single factor for the causation of diabetic retinopathy. There is a general agreement that the prevalance of

retinopathy in the diabetic population is positively associated with the duration of diabetes. In the recent study (by Kahn, H.A. and Brodley, R.F., 1975), the prevalance of diabetic retinopathy among patients at Joslin clinic, was 25% in total diabetic population. 7% is patients with diabetes for less than 10 years; 26% in patients with diabetes for 10 to 14 years; and 63% in patients with diabetes for 15 years or more. Retinal changes are rearely seen until the diabetic has been in existance for 3 years, a fact confirmed by all observers (Waite and Beetham 1935; Wagener 1945; J.S. Friedenwald 1950; Lawrance et al. 1951; Gardes 1953; G. Scott 1953 and many others). Patients who develop diabetes before the age of 15 or 16 show a frequency of 10% or less after 5-9 years of diabetes, of 50% after 15 years or so and 80-90% after 26 years or more. Lundback (1955) on the initial examination of 246 recently diabetics, in whom the disease had presumbly developed above the age of 40 years, found retinopathy present in only 4%, whereas Dollfus and Haige (1953), found that 90% of diabetics of over 18 year standing had retinopathy and Dolger (1947), examining cases of 25 year standing, concluded that not a single case had escaped.

Cristiansson's (1961) reported 45.6% of the patients had some form of retinopathy in an average diabetic duration of 16.7 year, a frequency that is in close agreement with the figure given by Kornurup (1955), namely 46.8% in large Swedish patients. On the other hand patients with proliferative retinopathy (Grade III and IV - Ballantyre 1946) in christianssons study shows 17.5% of the total case material with an average diabetic duration of 16 years the corresponding figures of Kornurup (1958), are 8.4% with the duration of 16.1 years the higher frequency in christiannsons study is due to age limit being fixed to 50.

But it is of interest to note that not all the diabetics with long duration of disease exhibit the retinopathy. Kinsell (1955) reports that Joslin was able to reward 45 patients with "Quarter - centuary victory Medal" in that they exhibited no signs of "Late diabetes syndrome", ever after 25 years of duration of diabetes. According to J.S. Friedenwald (1954), there are about 15-20% of diabetics who do not show diabetic retinopathy after 20-25 years of diabetes.

Khosla et al. (1984), found that more severe form of retinopathy was seen as the duration of diabetes increased,

(especially after 10 year period), but contrary to the usual, the prevalance of diabetic retinopathy is related to the duration of diabetes.

SEX INCIDENCE OF DIABETIC RETINOPATHY

Braun (1937), Hanum (1938), Heinsius (1939) and many others concluded that diabetic retinopathy is more common in females than males. Duke-Elder describes that female-male ratio is 3:2, and also that women are more liable to develop retinopathy. Proportion of female male ratio with diabetic retinopathy is about 4:3, while in some other studies there is much greater incidence among females; Hanum (1938), for e.g. in 183 cases of diabetic retinopathy found 72% females and 28% males. The larger statistics of Portsmann and Wiese (1954), Keiding et al. (1952), Janert et al. (1956) and Babel and Rilliet (1958), however did not show a difference between the sexes.

FREQUENCY OF RETINOPATHY AND SEVERITY OF THE DISEASE

Retinal lesions are observed in mild as well as severe cases. Hanum (1938) found retinopathy to be most common in diabetics of mild to moderate severity. Scott (1957) also believes that retinopathy is more common in light diabetes. O'Donoghass and Drury (1954), in contrast

to this found retinopathy to be more common the more insulin was required to control the diabetes. Mohmike also shows that retinopathy occures earlier and more commonly in severe cases. Waite and Beetham (1935), however finds no relationship at all between the requency of retinopathy and the severity of disease.

EFFECTS OF CONTROL OF DIABETES ON RETINOPATHY

The clinical and experimental evidence suggests that good control of metabokic aspects of diabetes delays the onset and decreases the severity of retinopathy to prove this prospective study of metabolic control has been performed in experiments with animals (Engerman R.L., Bloodworth J.M.B., 1973). They found that poorly controlled group developed retinopathy while striking reduction in incidence and severity of retinopathy in well controlled group.

DIABETIC RETINOPATHY IN RELATION TO TYPE OF DIABETES

The familier text book classification of diabetes into 'Juvenile onset' and 'Maturity onset' has now been largely abandoned by diabetologists. The classification adopted by the Americans Diabetic Association and WHO divides the majority of patients into type I (insulin dependant) and type II (non-insulin dependant) Abandant evidence show that these two have entirely different eitiopathogenesis. Majority of type I patients develop

the disease in childhood or in adolescence, but it is by no means confined to this age group. Type II predominantly affects the adult, life. Eitiology of type I is immune mediated destruction of islet B cells, while eitiology of type II remains largely unknown.

In Juvenile diabetes, retinopathy rarely occures before 16-18 years of age (Larson, 1960). In patients who were under 20 at the time of diabetes was discovered, the interval between this and visual loss was on an overage 17.4 years (Fertz and Berkov 1968).

About 20% of Juveniles with diabetes show changes in fundus (Chylinska and Abramowiez 1966; Darnaud et al. 1963). The proliferative from appears in about 10% of cases of Juvenile diabetic retinopathy. Prognosis in these cases is poor, about 50% having less than 6/60 vision in both the eyes after 5 years (Deckert et al. 1967). This type of Juvenile diabetic retinopathy appears between 10-14 years of age, while simple does not appear until 16-29 years (Michaelson 1980). The simple form of retinopathy appears in less than 10% of cases if diabetes has lasted for less than 10 year period; but it is found in at least 70% after 20 years of diabetes

(Knowles, 1965). Kohner (1977) has suggested that there is an association between proliferative retinopathy and 'Juvenile onset' diabetes and between 'diabetic maculopathy' and 'Maturity onset' Bodanosky, Cudworth, Whitelock and Dobree (1982) also confirms this view. They also report association between male sex and proliferative retinopathy.

The reported incidence of retinopathy in Juvenile onset diabetes is greater than in adult onset group because the patients live long enough for the retinopathy to develop. The highest percentage, 80% occured in cases of more than 15 year duration of diabetes. The onset of retinopathy in juvenile diabetes occurs after at least 6-7 year (Barta and Molnar 1970). Terne (1972) reported retinopathy in 67% of cases of juvenile onset diabetes compared to 43% of adult onset diabetes.

TONOMETRY

Tonometer is a devise that measures pressure through the dye ball. The first practical tonometer was that of Maklekoff (1885). The second applantion tonometer Fick (1888) employed a fixed area (0.05mm) of flattening produced by an adjustable force. The

modern version of this instrument, Goldmann (1954) is a very accurate clinical tonometer. An applanation tonometer that has been proved to be useful in the face of corneal edema or scarring as well as healthy cornea is the Machaya Marg tonometer. Kraker has recently developed a tonometer that senses the vibration, characterstic of cornea indentation tonometers, have been in use even longer than applanation tonometers. Most widely accepted indentation tonometer is the one deviced by Schiotz.

The various methods of measuring the Intra Ocular Pressure (IOP) are :-

(a) Digital Tonometery - The impressibility of ocular coats is estimated by the sense of fluctuation percieved on palpation, so its accuracy is therefore never high and depends entirely on clinical sense of the observer it is only useful to know gross deviation from normal.

(b) Manometery - Intra Ocular Pressure can be measured by a manometer connected to small bore cannula which is introduced into anterior chamber but this is invasive method moreover opening anterior chamber will lower the Intra Ocular Pressure. Otherwise this is most

accurate method.

(c) Instrumental Tonometery - It refers to measurement of impressibility of the tunics of the eye by deforming forces applied to those tunics. The impressibility of these tunics depends on the resistance offered by the eyeball to these forces and resistance in turn depends on its Intra Ocular Pressure and rigidity of coats. Thus instrumental tonometery gives an approx. measure of Intra Ocular Pressure. It is of 2 types -

(i) Indentation - measures depth of impression produced upon the ocular wall by a given force which is represented by a plunger.

(ii) Aplanation force necessary to flatten a known area of cornea is measured.

NORMAL INTRA OCULAR PRESSURE

The normal Intra Ocular Pressure denotes both statistical average pressure and pressure which is compatible with uninterrupted health and function of the eye. The average Intra Ocular Pressure has been recorded by different workers, have given values ranging from 15 to 35 mmHg.

Schiotz (1909) after studying a group of normal population found values ranging from 19 to 30 mmHg.

Alimuddin (1956) investigated 1000 eyes (669 males and 331 females) by Schiotz 'X' tonometers. He found average tension to be 19.0 mmHg.

Goldmann (1957) recorded normal Intra Ocular Pressure between 15 and 16 or more exactly 15.5 mmHg. The significant range of Intra Ocular Pressure by Schiotz tonometer explains that there are certain other factors which vary in different individuals, which give different readings. The two main factors that influence the Intra Ocular Pressure are -

(1) The position of patient and (2) The scleral rigidity McBain (1957 and 1958) demonstrated variation in an inverse direction of the eye balls rigidity with its Intra Ocular Pressure on enucleated eyes (Schiotz tension 18.8±0.4 at ocular rigidity 0.02±10.006). Same variation was observed by Ytteborg and Armaly (1960) in vivo i.e. Schiotz tension 13.3 and ocular rigidity 0.0272±0.0010.

Abrahamson and Abrahamson (1959) performed applanation and Schiotz tonometery in 250 normal individuals belonging to 22 to 24 year age group the

normal range was 14 to 24 mmHg. with a mean average of 18 mmHg. by both the methods, while Draeges (1959) found a mean value of 14.8 with Goldmann applanation.

Levve (1961) found a mean value of 15.6 mm of mercuery by applanation tonometer.

There is a significant difference in reading of Schiotz and applanation tonometer. At least 2 factors seen to take part, firstly the position of patient and secondly scleral rigidity.

Christiansson (1961) did applanation and Schiotz tonometery in 100 normal eyes with average age of 31 years and reported mean Intra Ocular Pressure of 14.4±0.3 by applanation which was short by 1mm of the value which Goldmann had quoted. The Schiotz tension was found to be 15.0±0.3 mmHg and this difference probably represent the effect of the changed position on episcleral venous pressure (Linner, Rikenbach and Weenes 1950, Goldmann 1957).

Pahwa (1961) measured Intra Ocular Pressure of 311 normal individuals by both Schiotz and applanation tonometer and mentioned that Intra Ocular Pressure measured by applanation technique is 2 mmHg lower than what is obtained by Schiotz in supine position.

Armaly (1962) in a comparative study of large sample did applanation and Schiotz tonometery and found Schiotz reading approx. 1mm more than that of applanation. He found mean Intra Ocular Pressure by applanation to be 15.92 mmHg while Schiotz tonometer reading was 16.86 mmHg.

Armaly and Solamoun (1963) compared the applanation reading in horizontal position with Schiotz. There was a poor agreement between the two systems of measurement. The Schiotz readings were markedly lower to applanation readings and were as followes -

Horizontal applanation - 17.36 mmHg ± 0.53
Schiotz reading - 15.1 mmHg ± 0.47

Schwartz and DecOso (1966) reported applanation reading averaging 1.1 mm higher than Schiotz when comparing applanation measurement while seated and Schiotz measurement in supine posture. This was based on finding of 502 individuals with normal eyes.

Jackson (1965) did a comparative study of applanation and Schiotz tonometers adding 1mm to all the reading of applanation technique as pressure is higher in recumbant than in upright position. They observed that 95% of applanation reading were the

Schiotz average ±0.5 mmHg.

INTRA OCULAR PRESSURE IN RELATION TO DIABETES AND ITS TYPES

It was Heine (1903 and Krause (1904) who first observed a striking hypotony of the eyeball during diabetic coma. Grafe (1924) and Poos (1930) drew attention to the extreme variations in blood sugar levels, considering that these reacted on the Intra Ocular pressure when conditions for a glaucoma were present. Igersheimer (1944) Philips (1946), Ortiz (1947, 1948), Weinstein (1949) and Larsen (1960) have all stressed how a changing Intra Ocular Pressure could, as a mechanical factor, initiate or favour the development of diabetic retinopathy.

Armstrong, Daily, Dobson and Girord (1960), on the basis of a relatively permanent Intra Ocular Pressure of 23.4 mmHg. or higher (Schiotz tension), have recently found an incidence of glaucoma in diabetes of at least 6.6%, while previously Waite and Beetham in 1935 and reported only 0.5% of clinical glaucoma in 2,002 diabetic patients.

The mean Intra Ocular Pressure in MODM is 19.26 mmHg (Arora and Prasad, 1989) which is higher than the normal mean Intra Ocular Pressure reported

in general population i.e. 16.1 mmHg (Becker and Schaffer), while in Juvenile diabetics the mean Intra Ocular Pressure though lower 17.93 mmHg than the mean Intra Ocular Pressure in maturity onset diabetes mellitus, was higher than the average normal mean Intra Ocular Pressure. However Palomar (1956) and Armaly and Baloglous (1967) observed low Intra Ocular Pressure in diabetics than non diabetics.

INTRA OCULAR PRESSURE IN REACTION TO DIFFERENT GRADES OF RETINOPATHIES

Christianssons (1960) studied 172 diabetic persons between 12-50 years of age, the aim was to observe the reaction of diabetic disease on the pressure of eye while ignoring as far as possible the influence of age. He found that the diabetic retinopathy was set up only in 45.6% cases, a similar co-relation was found by Kornurup (1955) i.e. 48.6%. He also reported that the diabetic eye have a higher Intra-Ocular Pressure than a corresponding normal eye. Insulin treatment seems to have but little relevance as regards this difference in tension. With increasing retinopathy the difference in tension is accentuated. Christiansion found that in grade I retinopathy Schiotz tension was 16.1 mmHg on an average mean, in grade II the tension decreased to 12.3 mmHg and in grade III

still decreased to 9.3 mmHg. He also reported eye with diabetic retinopathy of grade IV and V have lower Intra Ocular Pressure than other retinopathic group and the co-effecient of facility of outflow rises.

Arora and Prasad (1989), studied a total of 120 patients, out of which 60 were diabetics and rest were normal forming a control group. All the patients were thoroughly examined and besides careful tonometery estimation of scleral rigidity and estimation of facility of outflow was also done. Tonometery was done by standard certified Schiotz tonometer. They reported that out of total 60 patients 46 (76.67%) were of MODM, while Juvenile onset diabetes constituted only 23.3%. The mean Intraocular Pressure of diabetic eyes without retinopathy was 18.7 mmHg., while eyes with retinopathy was 19.99 mmHg. The significant finding was lower Intra Ocular Pressure, 15.98 mmHg in proliferative retinopathy. They saw in different groups viz. 20.98 mmHg. tension in grade I retinopathy, 21.99 mmHg in grade II and 22.18 Schiotz tension in grade III, while grade IV showed a lower level of 15.98 mmHg.

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MATERIALS AND METHODS

MATERIALS AND METHODS

The present study was carried out in the department of Ophthalmology, M.L.B. Medical College, Jhansi over a period of one year from 1990-1991. Diabetic patients attending the Diabetic clinic of department of Medicine and also those attending the Out Patient Department of Ophthalmology, coming therefore there routine eye check-up were all and only taken in our study. All the patients were thoroughly enamined with special emphasis on the patients intra-ocular tension and fundus, and were recorded on a pre-designed proforma.

Our case material was then grouped as:-

A. Control :- 17 Normal non-diabetic persons were taken as control for present study.

B. Study group :-

I. Cases having Juvenile Diabetes.

II. Cases having maturity onset diabetes mellitus (MODM).

SELECTION OF CASES

A. Control:- Total 17 cases were taken as control for the present study. The external examination of eye and detailed history was taken. Diseases affecting the intra-ocular pressure as iridocyclitis glaucoma, corneal ulcers etc. were not considered for the study. Those patients with normal internal examination of eye and fundus were taken.

B. Study group :-

I. Selection of Juvenile Diabetics

Those diabetics who are insulin dependent, usually have a positive family history, symptoms start abruptly, very rarely gradual, and patients are usually below 40 year of age.

II. Maturity onset Diabetes Mellitus

Persons not dependant on insulin, but showing hyperglycemia, symptoms start gradually, menifest after 40 year of age usually are MODM patients.

HISTORY, CLINICAL EXAMINATION AND INVESTIGATIONS

Detailed clinical history of the patient, his family history was taken and the cases were examined thoroughly. Eye was examined thoroughly for any ocular infections, or other associated disease. Then laboratory investigations, viz. Blood sugar levels Fasting or Random were done for each case. The intra-ocular tension was taken by Schiotz tonometer of both the eyes and detailed fundus examination was done.

PROCEDURE FOLLOWED DURING THE STUDY

After taking the history and examining the patients, Blood Sugar Levels for all the patients were recorded. Tension of both the eyes were recorded by the standard certified Schiotz tonometer, patient was made in recumbant position, 4% xylocaine instilled into eye 2-3 times, 1-2 drops each time, cornea was anaesthetized and then tension was taken. Same tonometer was used thoughout the study. Any person having very high tension was refered to glaucoma clinic and excluded form the study. Those cases with relatively high tension were examined and observed closely to exclude associated close angle glaucoma.

Pupils of the patients eyes were then dilated using 10% phenylepherine drops, 1-2 drops instilled at 5-10 minit interval, 3-4 times. Fundus was seen by direct ophthalmoscope and the retinal status was graded according to Wageners classification.

Statistical analysis was done to derive mean and standard deviation (S.D.). Mean values were compared using 't' test and significance of difference was tested.

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OBSERVATION

OBSERVATION

The present study was carried out in 43 cases of diabetes at M.L.B. Medical College, Jhansi between 1990-1991. 17 non-diabetic persons were also taken as control for the present study. A detailed clinical assesment haematological, and ophthalmological examination giving special emphasis to fundus examination were carried out to assess the diabetic retinopathy. Due emphasis was given to assess the Intra-Ocular Pressure in different grades of retinopathies.

A total of 60 cases were examined of which 17 cases served as control while the remaining 43 cases were diabetics. The control group comprised of 6 females and 11 males while the study group had constituted of 17 females and 26 males (Table No. 1).

Table No. 1

CASE MATERIAL ACCORDING TO AGE AND SEX

S.No.	Group	Total No.of cases	No. of cases	
			Female	Male
1.	Control group	17 (28.33%)	6(35.29%)	11(64.7%)
2.	Study group (Diabetics)	43 (71.66%)	17(39.53%)	26(60.4%)

The cases were again divided on the bases of type of diabetes mellitus i.e. Juvenile onset or maturity onset diabetes mellitus, of which total 6 cases belonged to Juvenile onset and 37 cases belonged to maturity onset diabetes mellitus (MODM) Female:Male ratio was 5:1 in Juvenile onset and 1:2.5 in MODM (Table No.2).

Table No. 2

CASE MATERIAL ACCORDING TO TYPE OF DIABETES MELLITUS

S.No.	Group	Total No. of cases	No. of cases	
			Female	Male
1.	Juvenile Diabetics	6	5	1
2.	MODM (Maturity Onset Diabetics	37	12	25

AGE DISTRIBUTION OF THE CASE MATERIAL

As is evident from the table No.3, that the majority of cases, viz. 28 cases (46.66%) were upto 50 year of age in diabetic group and only 15 cases were above this age, however in control group all the 17 cases (28.33%) were below 50 year of age.

Table No. 3

AGE DISTRIBUTION OF CASE MATERIAL

S.No.	Age in year (Grouping)	No.of cases Control group	No.of cases Diabetic group
1.	10 - 20	0	2
2.	21 - 30	5	5
3.	31 - 40	7	7
4.	41 - 50	5	14
5.	51 - 60	0	9
6.	7 60	0	6

SEX DISTRIBUTION OF CASE MATERIAL ACCORDING TO AGE

As shown in table No. IV, that maximum number of cases in control group are below 40 year of age, male female ratio being 1.1, while in study group the ratio is 1.3 (approx). However in age above 40 year 5:0 is the male female ratio in control group and 3:1 male female ratio in study group.

Table No. 4

SEX DISTRIBUTION OF CASE MATERIAL

S.No.	Age in year Grouping	Control		Diabetic	
		Male	Female	Male	Female
1.	10 - 20	0	0	1	2
2.	21 - 30	2	3	0	4
3.	31 - 40	4	3	3	4
4.	41 - 50	5	0	9	5
5.	51 - 60	0	0	7	2
6.	7 60	0	0	6	0

RETINAL STATUS OF EYES

Table No. V is showing that amongst the study group only 38 eyes (45.2%), shows the development of retinopathy while rest i.e. 46 eyes (54.7%) showed no retinopathy at all. In our study 2 eyes of 1 patient were excluded as pupil could not dilate due to development of ring synechie and dense mature catract making the view impossible.

Table No. 5
RETINAL STATUS OF EYES

S.No.	Retinal status	No.of eyes	Percentage
1.	Eyes without retinopathy	46	54.7
2.	Eyes with retinopathy	38	45.2
3.	Fundus not seen	02	-

Out of these 45.2% of cases, the retinopathy was graded (according to Wageners classification 1945) into I,II, III and IV grades. Most of the eyes (46) are of grade 0 i.e. no retinal changes seen in them. There are total of 13 cases in each of grades I and II, then grade III (8 eyes) and grade IV (4 eyes) shows a decreasing order. 2 eyes constituted a group where fundus was not seen (Table No. VI).

Table No. 6

CASE MATERIAL DISTRIBUTION ACCORDING TO GRADE OF RETINOPATHY

S.No.	Grade of Retinopathy	Total No. of Diabetic eyes		Percentage
		Male	Female	
1.	Grade 0	24	22	54.7
2.	Grade I	9	4	15.47
3.	Grade II	10	3	15.47
4.	Grade III	5	3	9.52
5.	Grade IV	4	0	4.76
6.	Fundus not seen	0	2	2.32

RELATION OF DURATION OF DIABETES TO THE RETINAL STATUS

As is evident from table No. VII that the average duration (in years) to develop retinopathy is 13.8 year. Grade I retinopathy which constitute 15.47% of the total material thus shows average diabetic duration of 13.8 year, grade II and III shows an average of 14.5 year in male population while in female population there is a decreased duration i.e. 10 year (approx) grade IV of proliferative retinopathy which constitutes 4.76% of the total case material shows the development of retinopathy in an average duration of 17.5 year.

Table No. 7

GRADE OF RETINOPATHY IN RELATION TO DURATION OF DIABETES

S.No.	Grade of retinopathy	Duration of Diabetes(In years) Female	Male	Average
1.	Grade 0	3.2	4.9	4.05
2.	Grade I	14.5	12.0	13.25
3.	Grade II	9.33	15.0	12.16
4.	Grade III	10.66	14.2	12.40
5.	Grade IV	Nil	17.5	17.5

INTRA-OCULAR PRESSURE IN DIFFERENT TYPES OF DIABETES MELLITUS

Intra-Ocular Pressure which was taken by Schiotz indentation tonometer was taken in all the subjects taken as a control or the study group. The average Intra-Ocular Pressure shows a definite increase as((18.85 mmHg) in MODM and 20.3 mmHg in Juvenile onset diabetes mellitus) as when compared to the normal control group (17.3 mmHg) (Table No.VIII).

Table No. 8

MEAN INTRA OCULAR PRESSURE IN DIFFERENT TYPES OF DIABETES

S.No.	Group(Type of diabetes)	Number of patients	Mean Intra-Ocular Pressure(IOP)
1.	Number of MODM	37(61.66%)	18.85±4.2
2.	Juvenile	6(10.00%)	20.3±2.7
3.	Normal control group	17(28.35%)	17.3±1.8

INTRA OCULAR PRESSURE IN RELATION TO RETINAL STATUS

Intra Ocular Pressure in diabetics shows a definite increase as when compared to non-diabetic persons. In grade 0 patients who are diabetics but they have not developed any retinopathy as yet, forming a total of 54.76% of the total cases, shows mean Intra-Ocular Pressure (IOP) of 18.3 mmHg. Thereafter there is an increasing order in any Intra-Ocular Pressure as the grade of retinopathy increases ultimately at the proliferative stage (grade IV) when the pressure shows a drop, at 15.27 mmHg on an average (Table No. IX).

Table No. 9

INTRA OCULAR PRESSURE IN RELATION TO RETINAL STATUS

Retinal status	No.of eyes	Percentage	Mean IOP
Diabetes without retinopathy	46	54.76	18.3±3.3
Diabetes with:			
(a) Grade I Retinopathy	13	15.47	18.95±3.3
(b) Grade II	13	15.47	21.66±2.6
(c) Grade III	8	9.52	20.35±2.0
(d) Grade IV	4	4.76	15.27±1.1

COMPARISON OF INTRA OCULAR PRESSURE IN DIABETES

It is evident from table No. II that total 6 cases of Juvenile diabetes and 37 cases of MODM were taken in our study and a comparision was made between the control group and study group (Both Type I and Type II separately).

Table No. X shows that irrespective of the type of diabetes, P values are significant on comparison between control and study group. P value being highly significant ($P < 0.001$) in Type I group and significant in MODM ($P < 0.01$) or Type II.

Table No. 10

INTRA OCULAR PRESSURE IN DIFFERENT TYPES OF DIABETES

Type of Diabetes	IOP $\bar{X} \pm SD$	$\bar{X} \pm SD$ Control IOP	P Value
Juvenile(Type I)	20.3±2.7	17.3±1.8	<0.001
MODM (Type II)	18.85±4.2	17.3±1.8	<0.01

When comparing the Intra-Ocular Pressure between control group and groups of different grades of retinopathies, we find that P value is not significant ($P>0.05$) in retinopathy of grade 0, 10 : being 18.3±3.3 mmHg grade I retinopathy also shows similar phase i.e. P value not significant ($P>0.05$) at Intra Ocular Pressure (IOP) of 18.9±3.3 mmHg. Grade II, III and IV retinopathy shows highly significant P values ($P<0.001$) at Intra-Ocular Pressures of 21.6±2.6, 20.35±2, 15.2±1.1 mmHg respectively (Table No. XI).

Table No. 11

INTRA OCULAR PRESSURE IN DIFFERENT GRADES OF RETINOPATHIES

Grade of Retinopathy	IOP $\bar{X} \pm$ SD(mmHg)	Control IOP $\bar{X} \pm$ SD	P Vale
0	18.3±3.3	17.3±1.8	>0.05
I	18.9±3.3	17.3±1.8	>0.05
II	21.6±2.6	17.3±1.8	<0.001
III	20.35±2.0	17.3±1.8	<0.001
IV	15.27±1.1	17.3±1.8	<0.001

DISCUSSION

DISCUSSION

The primary aim of our study was to :-

(a) Study the relationship of Intra Ocular Pressure diabetics and non-diabetic persons and

(b) To study the effect of different stages of diabetic retinopathy on Intra Ocular Pressure.

Furthermore we have also seen the effect of duration of diabetes on the development of retinopathy.

A total of 60 cases were selected of which 17 were normal non-diabetic persons acting as control and the remaining 43 cases were diabetic persons. We had also divided diabetic cases into Juvenile diabetics (Type I diabetes) and maturity onset diabetes (MODM) or Type II diabetes.

Detailed clinical examination of each eye was done in all the 43 patients and special emphasis was given to the intra-ocular tension and fundus; grading of retinal status was done by according to Wageners classification. Blood sugar level fasting or random, according to the availability were recorded in all the cases. Based on the observations depicted in tables No. 1 to 2, following inferences were drawn and discussed

under different headings.

It is evident from table No. 1 that amongst the study group of cases, the majority of cases 60.4% were males and 39.5% were females while in control group it was 64.7% were males and 35.2% females, this forms male female ratio of 2:1. Table No. 2 reveals that the majority of cases in Juvenile diabetes were females as compared to maturity onset diabetes in which males were predominating. Duke-Elder describes that female-male ratio is 3:2, and also that women are more liable to develop retinopathy. Proportion of female male ratio with diabetic retinopathy is about 4:3, while in some other studies there is much greater incidence among females; Hanum (1938), for e.g. in 183 cases of diabetic retinopathy found 72% females and 28% males. The larger statistics of Portsmann and Wiese (1954), Keiding et al. (1952), Janert et al. (1956) and Babel and Rilliet (1958), however did not show a difference between the sexes. The reason for the predominance of females in Juvenile (Type 1) diabetes is because of more susceptibility of females to have diabetes, while in MODM, males out number females probably because they are more concious about their health (Table No. 3 and 4).

RETINAL STATUS OF EYES

Table No. 5 shows the retinal status of case material. Eyes with retinopathy which forms total of 38 eyes i.e. 45.2% of the total case material is in close agreement with the prior studies viz., Wagener's (1921) found the incidence of 8.3% of diabetic retinopathy among diabetics (Wagener and Wilder 1921), in 1934, the incidence has risen to 17.7% (Wagener et al. 1934) and in 1945 it was 29.6%; Kormurup (1957) found 601 cases of diabetic retinopathy out of 1285 unselected diabetics (47%) and Dollfus (1954) reported 52.4% cases. It therefore followes that the incidence of diabetic retinopathy is on an increase and is expected to have above 50% cases of diabetic retinopathy at present.

As has been broadly classified earlier (Table No.6), amongst the different grades of retinopathy, there were 24 males and 22 females (54.7%) in grade O retinopathy, 9 males and 4 females (15.4%) in grade I retinopathy, 10 males and 3 females (15.47%) in grade II, 5 males and 3 females in grade III (9.52%) and 4 males only in grade IV were taken in our study. Christianssons (1960) too found maximum number of cases in grade O viz. 44 males and 49 females, 17 males and 19 females in grade I,

in grade II 6 males and 6 females, in grade III 7 males and 4 females and finally 11 males and 8 females in grade IV, showing a decreasing order.

In our study we observed that the diabetic retinopathy develops in diabetic patients in 13.8 year while Christianssons (1961) reported retinopathy to develop on an average 16.7 year of duration; a figure which was in close relation with the studies of Kormurup (1955) Upteem workers in the past had reported that a minium of 3 year period is required to develop any retinopathy (Waite and Beetham 1935; Wagener 1945; J.S. Friendenwald 1950; Lawrance et al. 1951; Gardes 1953; G. Scott 1953).

To develop proliferative retinopathy, our study showed an average duration of 17.5 years on the other hand, patients with proliferative retinopathy (Christianssons 1960), constitute 17.5% of total case material with an average diabetic duration of 16 year. Kormurup (1958) also had same figures of 16.1 year of diabetic duration to develop proliferative retinopathy.

Another important observation in our study was a decreased duration in grade II and III, and that too in females only. This is 9.33 year in grade II retinopathy,

and 10.7 year in grade III retinopathy. This is because apart from the duration of diabetes, age of the patient etc., it is also the severity of the disease which affects the development of retinopathy. It was found that out of total of 6 Juvenile diabetics, 3 had grade II and III retinopathy i.e. 6 eyes (7.17%), and their blood sugar levels were 334 mg% on an average (though duration in years was ten). This observation is in co-relation with O. Donoghan and Druey (1954) who found retinopathy to be more common, the more insulin was required to control the diabetes. Mohmike also shows that retinopathy ocures earlier and more commonly in severe cases. Waite and Beetham (1935) however found no relationship at all between frequency of retinopathy and severity of disease (Table No.7).

MEAN INTRA OCULAR PRESSURE

The fact that mean Intra Ocular Pressure is definitely more in diabetic's, being, 18.85±4.2 in maturity onset diabetes and 20.3±2.7 in Juvenile diabetes; as when compared to mean Intra Ocular Pressure in normal population (17.3±1.8) has been clearly demonstrated in our study from table No. 8. The value between normal

control and maturity onset diabetics being statistically significant ($P < 0.01$) and in Juvenile diabetics it is found to be very significant ($P < 0.001$).

However, various workers, viz. Palomar (1956) and Armaly and Baloglour (1967) observed low Intra Ocular Pressure in diabetics as compared to non-diabetics. Arora and Prasad 1989, like us, have reported, mean Intra-Ocular Pressure in maturity onset diabetes mellitus to be 19.26 mmHg which is higher than normal mean Intra-Ocular Pressure reported in general population i.e. 16.1 mmHg (Becker and Schaffer), while in Juvenile diabetics the mean Intra Ocular Pressure though lower 17.93 mmHg than the mean Intra Ocular Pressure in MODM, was still, higher that normal average mean Intra Ocular Pressure.

INTRA OCULAR PRESSURE IN RELATION TO RETINAL STATUS

It is evident from table No. 9 that, total of 46 eyes (54.76%), of diabetics had no retinopathic changes in fundus and the mean Intra Ocular Pressure in them is 18.3 ± 3.3 which is difinitely more than normal Intra-Ocular Pressure of control group i.e. 17.3 ± 1.8, though values between the two are statically not very significant ($P > 0.05$) but still on an average there is a definite difference between the Intra Ocular Pressure of two groups.

Another important interesting observation of our study was that, as the grade of retinopathy increased, the mean Intra Ocular Pressure also showed an increasing tendency until at the final stage (grade IV retinopathy) it declined steeply.

In grade I retinopathy, out of 13 eyes (15.47%) mean average Intra Ocular Pressure is found to be 18.95±3.3. The values when compared with normal control group dosen't stastically show a significant difference ($P > 0.05$) though here also overlooking the P value, we do find a definite increase in mean Intra Ocular Pressure as when compared to normal control group.

Grade II retinopathy, similarly, following the tradition showed an increase in mean average Intra-Ocular Pressure i.e. 21.66±2.6. Here the values are found to be statistically very significant ($P < 0.001$) and ultimately in grade III retinopathy out of 8 eyes which formed a total of 9.52%, showed 20.35±2.00 of mean Intra-Ocular Pressure which is again when compared to normal control group shows a very significant value ($P < 0.001$).

But above all this the most interesting observation in our study is seen when grade IV retinopathy and its mean Intra Ocular Pressures are considered. Out of 4 eyes (4.76%) of grade IV retinopathy,

the mean Intra Ocular Pressure was 15.27±1.1 which when compared to control group 17.3±1.8, ® shows quite good amount of difference. The same values when statistically compared therefore showed a very significant difference (P/0.001).

On comparision of mean Intra Ocular Pressure observed by us in different grades of retinopathies, to that of other workers, we find a similar co-relation was found by Arora and Prasad (1989); who studied a total of 120 patients, out of which 60 were diabetics forming the study group and 60 non-diabetics forming the control group. They found mean Intra-Ocular Pressure in diabetics without retinopathy to be 18.17 mmHg. while in eyes with retinopathy it was 19.99 mmHg (in our study the Intra-Ocular Pressure in diabetics with retinopathy is 19.05 mmHg). Arora and Prasad found significant difference in mean Intra-Ocular Pressure in proliferative retinopathy when compared to normal control group. The value is 15.98 mmHg in grade IV or proliferative retinopathy. In others, like us, they found Intra-Ocular tension of 20.98 mmHg in grade I retinopathy, 21.99 mmHg in grade II retinopathy and 22.18 Schiotz tension in grade III retinopathy.

In contrast to our findings, Christianssons (1960) who studied total of 172 diabetic patients though found similar ratio of retinopathy developing in diabetics (45.6% cases) is found in our study being (45.2%), but unlike us, he found a decreasing Schiotz tension as the grade of retinopathy increased viz. 16 mmHg in grade I retinopathy in grade II, the tension decreased to 12.3 mmHg and in grade III 9.3 mmHg. He said that tension further decreased in grade IV and V retinopathies but he didn't give the exact values.

In nutshell, our study amply demonstrates and collaborates the earlier findings, that the mean Intra-Ocular Pressure in diabetics is higher than the pressure in general population and that the pressure rises with the increasing grades of retinopathies. The study has also indicated that as the duration of diabetes is increased, it is directly related to the retinopathic grade, besides other factors affecting it, as the insulin requirement and age group of the patient.

We therefore conclude that the mean Intra-Ocular Pressure in diabetics is more than the mean Intra-Ocular Pressure in non-diabetics and that this Intra-Ocular Pressure increases as the grade of retinopathy increases ultimately showing a downfall at last stage i.e. proliferative retinopathy.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

Present work was carried out to evaluate the inter ocular pressure's in diabetics and non-diabetic persons and know if any difference is present between them the present study was also directed to desire a co-relation between the intra ocular pressure and different grades of retinopathies.

A total of 60 patients were selected, of which 17 normal non-diabetic persons served as control, while the remaining 43 were diabetics forming a study group, the study group comprised of 6 Juvenile or (Type I) diabetes and 37 cases of Type III or maturity onset diabeties.

Besides taking the intra ocular tension by Schiotz tonometer, pupils of all the patients were dilated and diabeties were divided into those with retinopathy and those without retinopathy. Retinopathy was thus divided into grades I, II, III and IV retinopathy by direct ophthalmoscopy.

Amongst the study group cases, we found that eyes without retinopathy were 54.7%, and those with retinopathy were 45.2% while the control group formed 28.33% of total cases material. Out of these group constituting eyes with retinopathy, eyes with grade I retinopathy constituted 15.47% grade II being in 15.47% eyes and grade III in 9.52% while grade III retinopathy was present in 4.76% of the eyes. In 2 eye fundus could not be seen due to mature cataract both eyes, with ring synechis, so that the pupils also did not dilated.

INTRA-OCULAR PRESSURE IN DIFFERENT TYPES OF DIABETES

Intra-Ocular Pressure was estimated by a standard certified Schiotz tonometer in all the cases i.e. group as well as control group. Out of the study group, the average mean intra-ocular tension in MODM in our study was 18.85 ± 4.2 while in Juvenile diabetes it was 20.3 ± 2.7. The control group also showed mean average Intra-Ocular Pressure (IOP) of 17.3 ± 1.8. The values were statistically significant when MODM and normal were compared (P value < 0.01) and they were very significant when Juvenile and normal control were compared (P value < 0.001).

When different grades of retinopathies and their mean Intra-Ocular Pressure were compared to the normal control group, the highest Intra-Ocular Pressures were seen in grade II and III retinopathies i.e. value of 21.66±2.6 mmHg and 20.35±2.0 mmHg respectivel. Both when compared with normal, showed a very significant change statistically (P value $<$0.01).

Mean Intra-Ocular Pressures of 18.3±3.3 mmHg and 18.95±3.3 mmHg were found in diabeties without retinopathy and grade I retinopathy respectively. Both, though, are being definetly higher than normal average Intra-Ocular Pressure of 17.3±1.8, but when statistically seen did not show any significance (P value $>$0.05).

Grade IV retinopathy showed a decreased mean Intra-Ocular Pressure i.e. 15.27±1.1 mmHg and the value is statistically very significant (P value $<$0.001).

A part from Intra-Ocular Pressure in diabeties and its different retinopathic group we also studied the relation between the development of retinopathy and duration of disease.

Leaving aside the age of the patient, and the severity of disease the retinopathy seems to develop on an average of 13.8 years. We also observed from our study that as the duration of diabetes increases, the severity

of retinopathy also increases.

We therefore conclude that the mean Intra-Ocular Pressure is higher in cases of diabetics when they are compared to normal ones and that as the severity of retinopathy increases the Intra-Ocular Pressure also increases but if we find lower than normal pressure in a diabetic that indicates the possibility of proliferative or grade IV retinopathy, which confirms the common saying that 'glaucoma in a diabetic case protects him to develop proliferative retinopathy'. Besides looking into the Intra-Ocular Pressure, we also conclude that as the duration of diabetes increases, the severity of diabetic retinopathy also increases.

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